PAGE 7/11 * RCVD AT 2/17/2006 11:23:41 AM [Eastern Standard Time] * SVR:USPTO-EFXRF-6/31 * DNIS:2738300 * CSID:4079267720 * DURATION (mm-ss):03-04

FEB-17-06 11:25 FROM-BEUSSE WOLTER ET AL 4079267720 T-736 P.07/11 F-189

BEST AVAILABLE COPY

MATERIALS DEVELOPMENT CORPORATION

Home

Borofuse Process

Suitable Metals

Foils & Brazes

Applications

Contact Us

Foils & Brazes

NI-FLEX™ nickel based braze alloys in ductile foil and wire

Nickel-based brazing alloys are extensively used for the joining of nickel-based materials, as well as for a wide variety of stainless steels. Generally these bonding alloys contain boron and/or silicon as a melting point depressant, thereby permitting brazing to be carried out at temperatures compatible with the materials to be joined. Boron levels fall within the range of 2.0-3.5 weight percent, dependent on the specific braze material. At these boron levels, nickel-based brazing alloys exhibit virtually no ductility at room temperature; consequently, these materials are conventionally supplied as powders, pastes, or plastic bonded powders in sheet form. Although many joining requirements are best suited to the use of foil or wire bonding alloys, the ductility problem stated above has precluded the availability of most of the boron containing nickel-based braze alloys in foil or wire form.

A new class of nickel-based filler alloys in the form of ductile foil and wire has been developed by Materials Development Corporation. This technology is based on the controlled diffusion of boron into metals. The material is produced to its final configuration prior to the introduction of boron, thereby eliminating the ductility problem which accompanies the presence of boron. Boron is then added by diffusion into the surfaces to produce a composition suitable for brazing.

DUCTILE BRAZE FOIL

High quality ductile braze foils of close composition and thickness control are now available. The following example outlines the basic procedures used to produce these materials.

A boron-containing braze alloy such as AMS 4778 (3% B, 4.5% Si, Bal. Ni) is

PAGE 8/11 * RCVD AT 2/17/2006 11:23:41 AM [Eastern Standard Time] * SVR:USPTO-EFXRF-6/31 * DNIS:2738300 * CSID:4079267720 * DURATION (mm-ss):03-04

FEB-17-06 11:25 FROM-BEUSSE WOLTER ET AL 4079267720 T-736 P.08/11 F-189

BEST AVAILABLE COPY

produced as foil in the boron free, ductile condition. In this example , a nickel-silicon foil is produced to the desired thickness (e.g., .002") by conventional foil-making practices. Boron is then diffused into the surfaces to achieve an overall level of 3.0 weight percent. The boron is presented as borides throughout the diffused zone, whereas the core remains ductile. Foil produced in this manner displays excellent ductility due to the boron-free, ductile core. Pre-forms of the appropriate configuration can be produced from the foil by conventional methods such as stamping and photoetching. Fig. 1 shows the basic steps involved in producing ductile bonding foil

Brazing cycles appropriate to the particular alloy are used in the bonding process, during which the entire foil melts, producing a homogeneous liquid of the filler metal. This method is used to produce a fully dense, ductile braze foils of precisely controlled thickness. Braze alloys that can be produced include any of the boron-containing compositions which, in a boron free state, exhibit reasonable ductility. This includes, but is not restricted to, such widely used alloys as AMS 4775, 4776, 4777, 4778 and 4779.

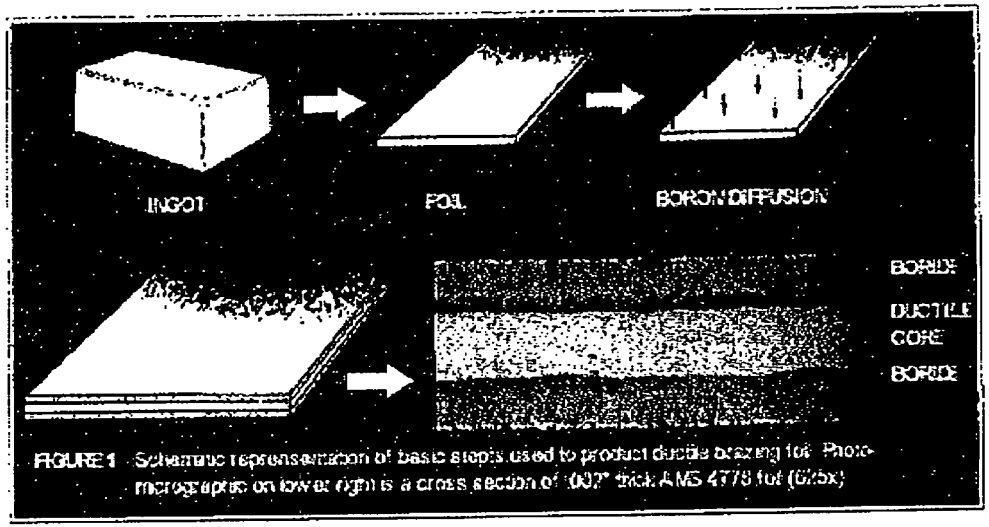


FIGURE 1 - Schematic representation of basic steps used to product ductile brazing foil. Photo-micrographic on lower right is a cross section of .002" thick AMS 4778 foil (625x)

BRAZE WIRE

In many applications, it is desirable to use wire pre-forms for diffusion

PAGE 9/11 * RCVD AT 2/17/2006 11:23:41 AM [Eastern Standard Time] * SVR:USPTO-EFXRF-6/31 * DNIS:2738300 * CSID:4079267720 * DURATION (mm-ss):03-04

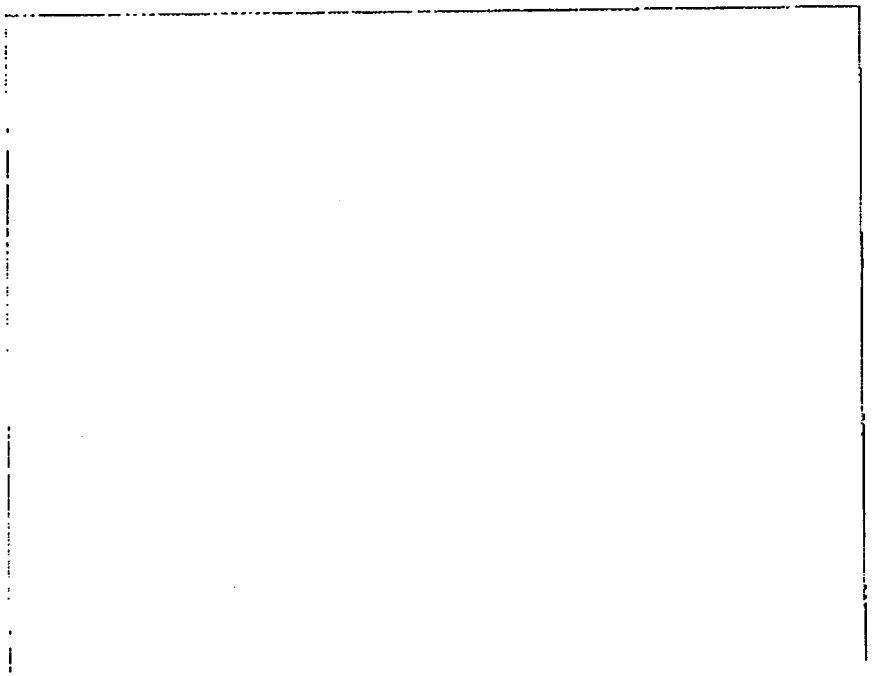
FEB-17-06 11:26 FROM-BEUSSE WOLTER ET AL 4079267720 T-736 P.09/11 F-189

BEST AVAILABLE CO

brazing. For example, the placement of a wire ring for the joining of tubing is common practice. The ability to work with gold-based alloys as wire has led to substantial use in applications where nickel-based filler alloys possess the proper oxidation and mechanical properties, but cannot be used due to the limitations imposed by powder-based brazing systems.

The techniques described above are being used to produce fully dense, nickel-based braze wire. As with the foil, wire is drawn in the boron-free, ductile state. Pre-forms are then produced to any desired configuration . Boron is subsequently diffused into the surfaces to achieve the proper finished braze composition.. Brazing is carried out in the normal manner, consistent with the specific composition being used. Fig. 2 outlines the basic steps followed in production braze wire pre-forms.

For further information on braze alloy foil and wire, especially as it relates to your specific application, you're invited to contact our sales engineering department, telephone (781) 391-0400



PAGE 10/11 * RCVD AT 2/17/2006 11:23:41 AM [Eastern Standard Time] * SVR:USPTO-EFXRF-6/31 * DNIS:2738300 * CSID:4079267720 * DURATION (mm-ss):03-04

FEB-17-06 11:26 FROM-BEUSSE WOLTER ET AL 4079267720 T-736 P.10/11 F-189

BEST AVAILABLE COPY

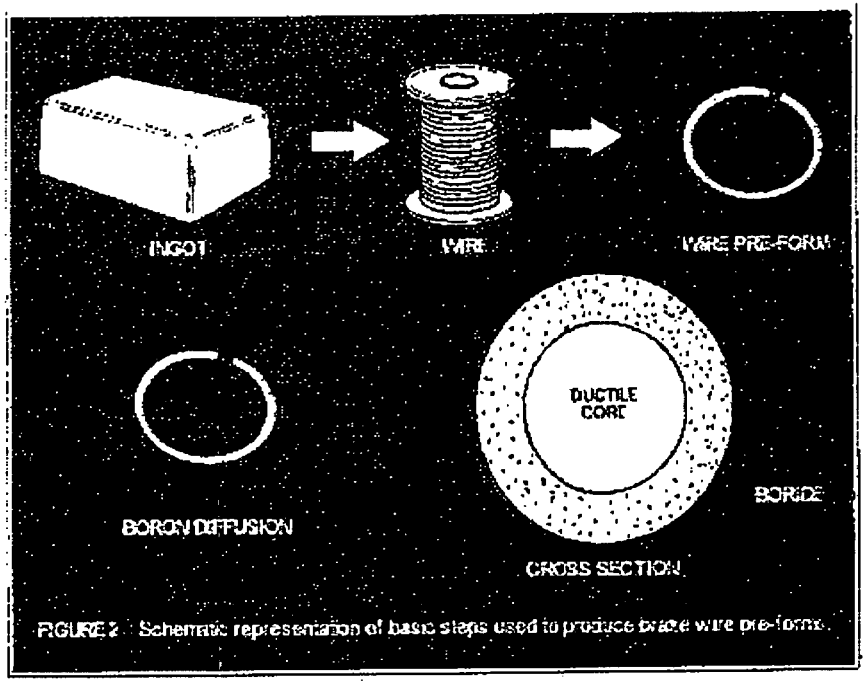


FIGURE 2 Schematic representation of basic steps used to produce braze wire pre-forms.

MDC Alloy	AMS SPEC	AWS SPEC	PRATT & WHITNEY	GENERAL ELECTRIC	ROLLS ROYCE MSRR-9500
Ni-FLEX76	4776	BNi-1a			
Ni-Flex 76A			PWA-996		705
Ni-Flex 77	4777	Bni-2		B50TF204	97
Ni-Flex 78	4778	Bni-3		B50TF205	114
Ni-Flex 79	4779	Bni-4		B50TF206	700
Ni-Flex 95				B50TF207	719
Ni-Flex 77 (mod)			PWA-1183		
Ni-Flex 95 (mod)			PWA-1180		

Ni-Flex foils are available in any thickness to 0.001" +/- 0.0001"
Ni-Flex wire diameters are available between 0.01 and 0.050".
Special alloys, preforms, and wire diameters are available.

Home The Borofuse Process Suitable Metals Foils & Brazes Applications Contact Us

Copyright © 2002 - Materials Development Corporation - All Rights Reserved
81 Hicks Avenue - Medford, Massachusetts 02155-6318
Tel 781-391-0400 - FAX: 781-391-7964 - Email: mdc1@quik.com

PAGE 11/11 * RCVD AT 2/17/2006 11:23:41 AM [Eastern Standard Time] * SVR:USPTO-EFXRF-6/31 * DNIS:2738300 * CSID:4079267720 * DURATION (mm-ss):03-04

FEB-17-06 11:26 FROM-BEUSSE WOLTER ET AL 4079267720 T-736 P.11/11 F-189

BEST AVAILABLE COPY